



# Main Propulsion for the Ares Projects

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- ◆ **The NASA Ares Projects Office is developing the launch vehicles to support exploration beyond low earth orbit for decades to come**
- ◆ **Ares I is a crewed vehicle, and Ares V is a heavy lift vehicle being designed to launch cargo into LEO and transfer cargo and crews to the Moon**
- ◆ **The performance, reliability, operability, and cost of the Ares propulsion systems are critical to everything we aspire to do.**
- ◆ **Ares propulsion systems are based on heritage hardware and experience from Apollo to the Space Shuttle to current ELVs**
- ◆ **My goal today is to update you on the status of Ares propulsion systems**



# Our Exploration Fleet

## What Will the Vehicles Look Like?



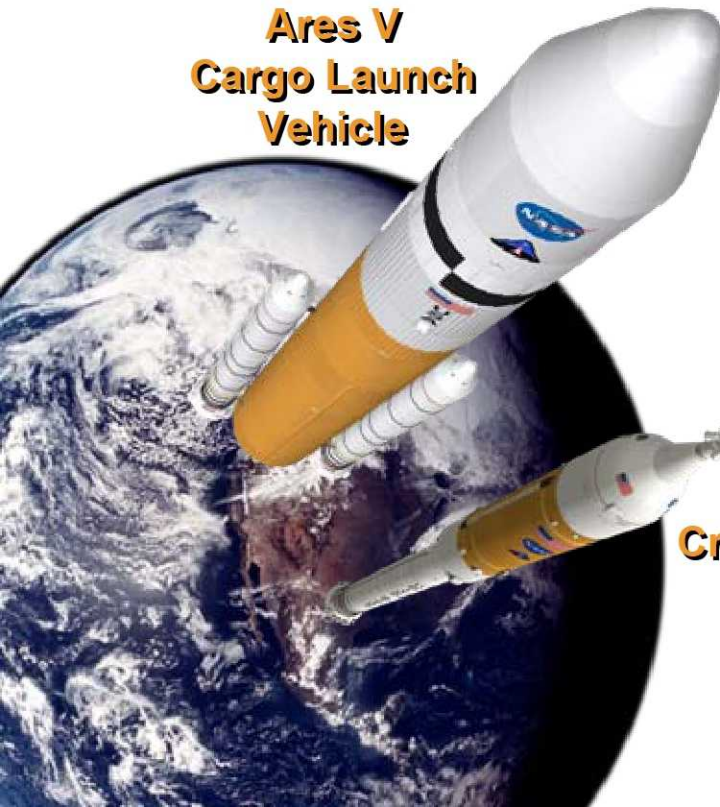
**Earth Departure Stage**



**Orion  
Crew Exploration  
Vehicle**



**Ares V  
Cargo Launch  
Vehicle**



**Ares I  
Crew Launch  
Vehicle**



**Altair  
Lunar  
Lander**

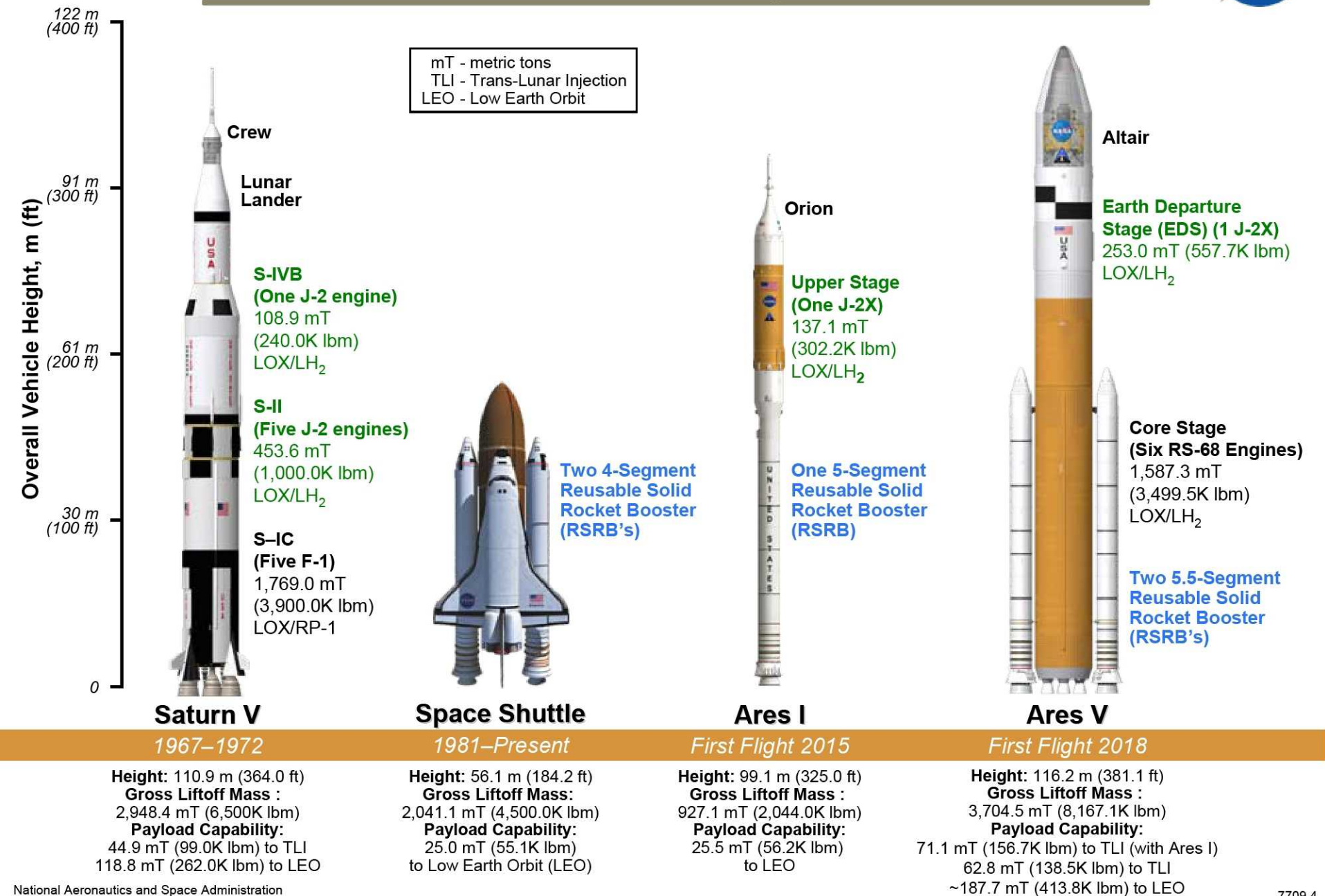






# Building on a Foundation of Proven Technologies

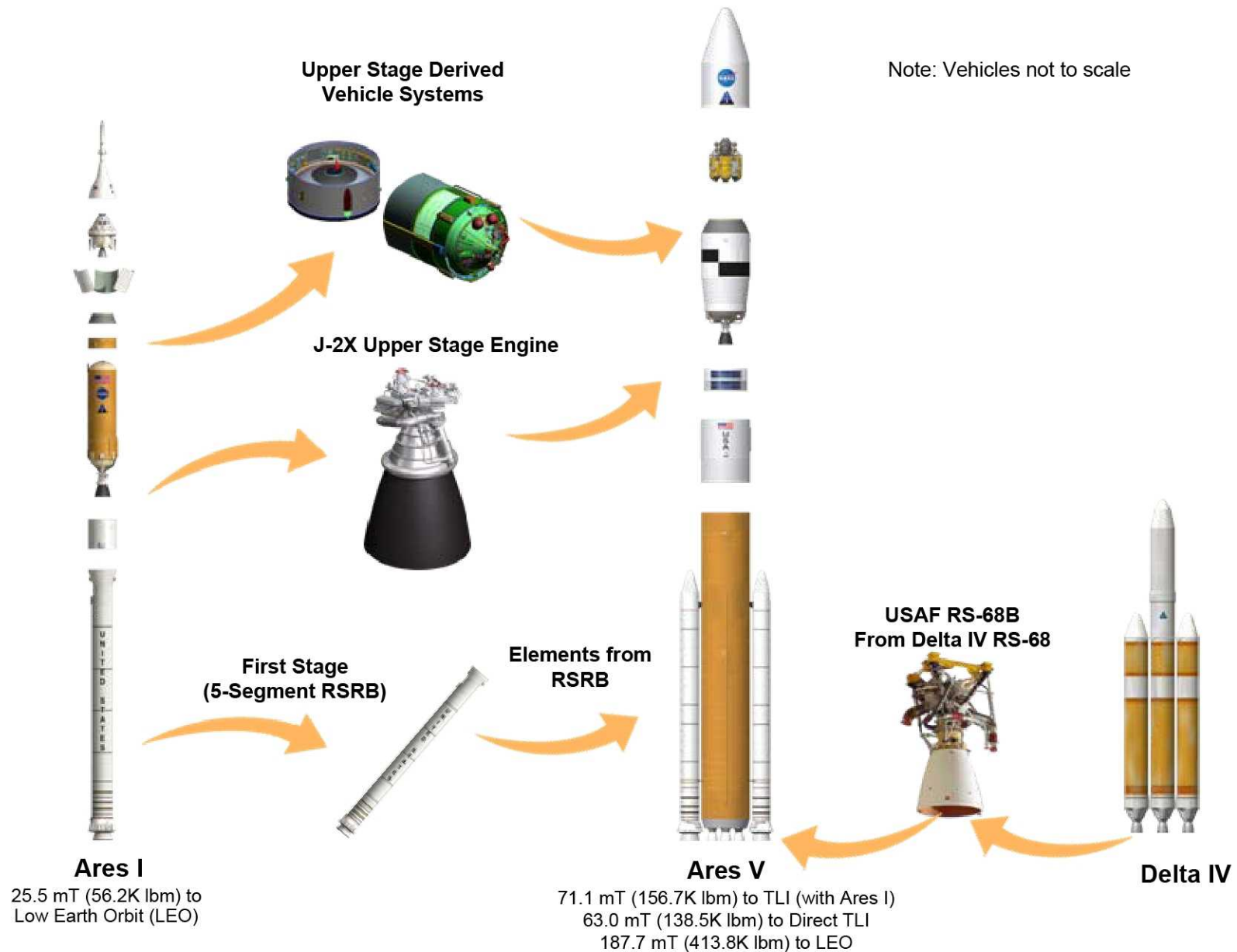
## - Launch Vehicle Comparisons -



# Ares Vehicles: Commonality & Heritage Hardware

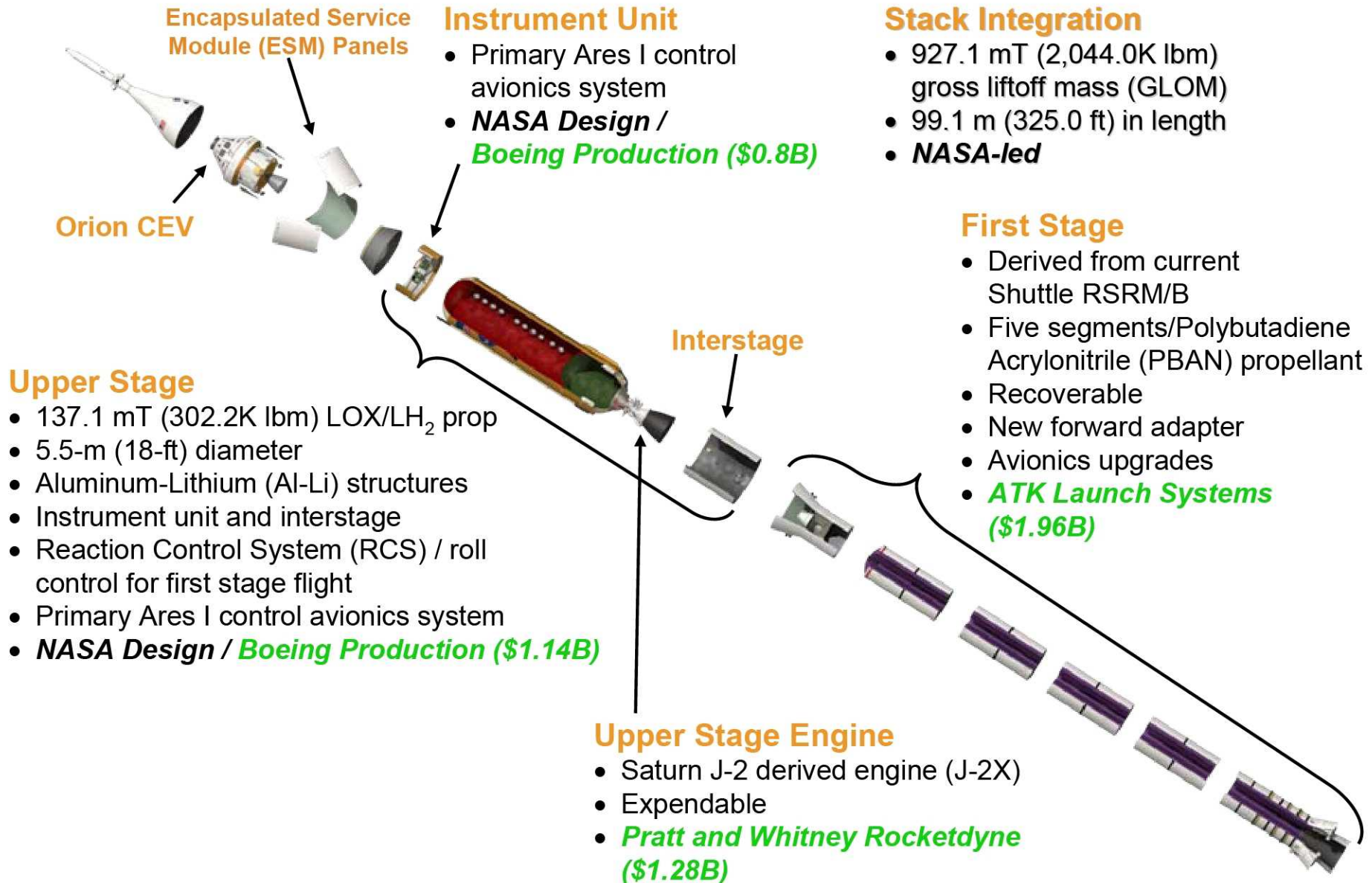


Note: Vehicles not to scale





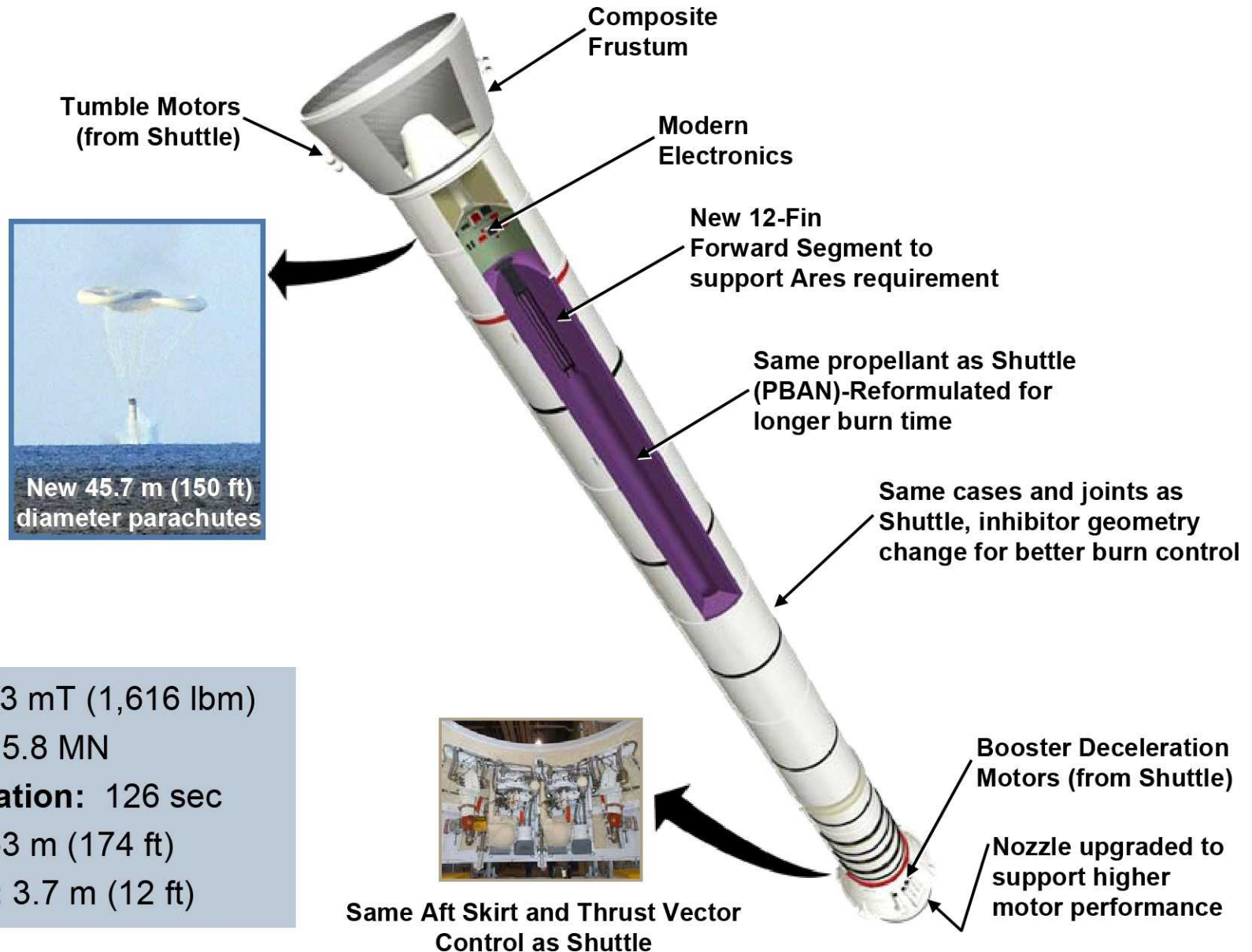
# Ares I Elements





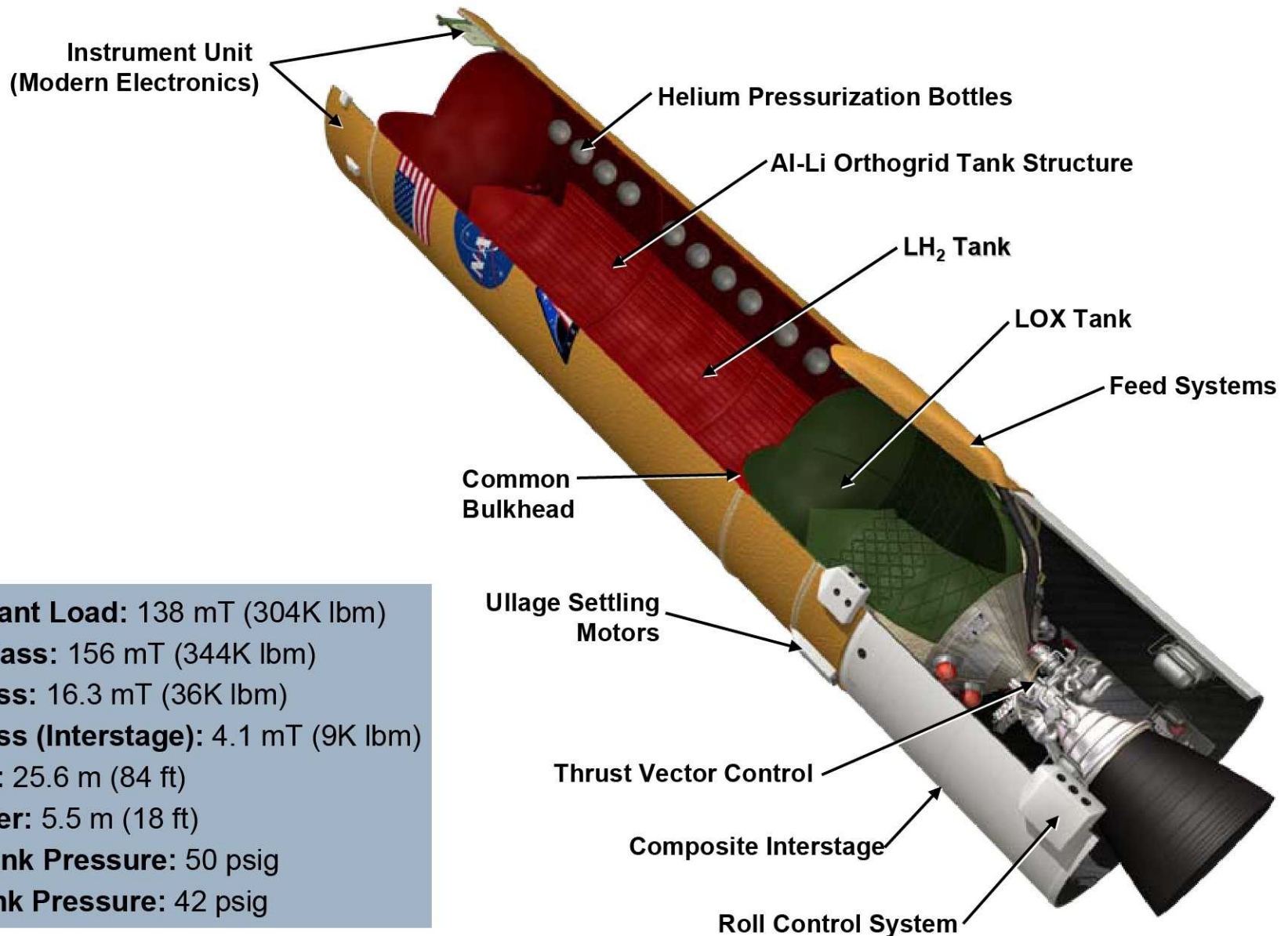


# First Stage





# Upper Stage



**Propellant Load:** 138 mT (304K lbm)  
**Total Mass:** 156 mT (344K lbm)  
**Dry Mass:** 16.3 mT (36K lbm)  
**Dry Mass (Interstage):** 4.1 mT (9K lbm)  
**Length:** 25.6 m (84 ft)  
**Diameter:** 5.5 m (18 ft)  
**LOX Tank Pressure:** 50 psig  
**LH<sub>2</sub> Tank Pressure:** 42 psig



# J-2X Upper Stage Engine for Ares I and Ares V



## ◆ Upper Stage Engine Element challenge:

Design an engine...

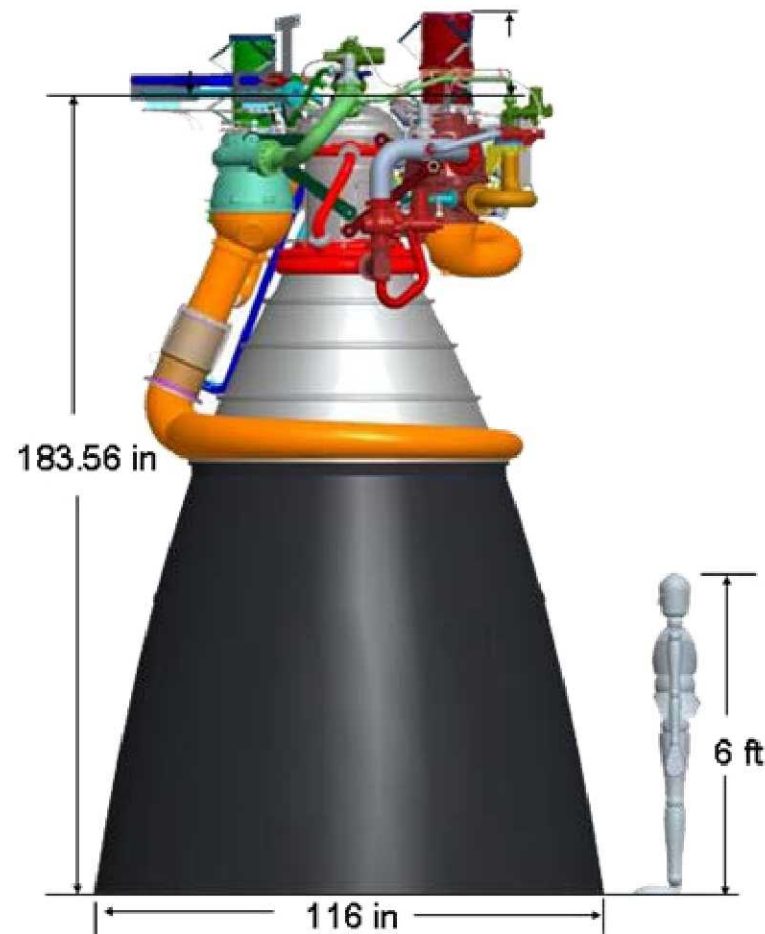
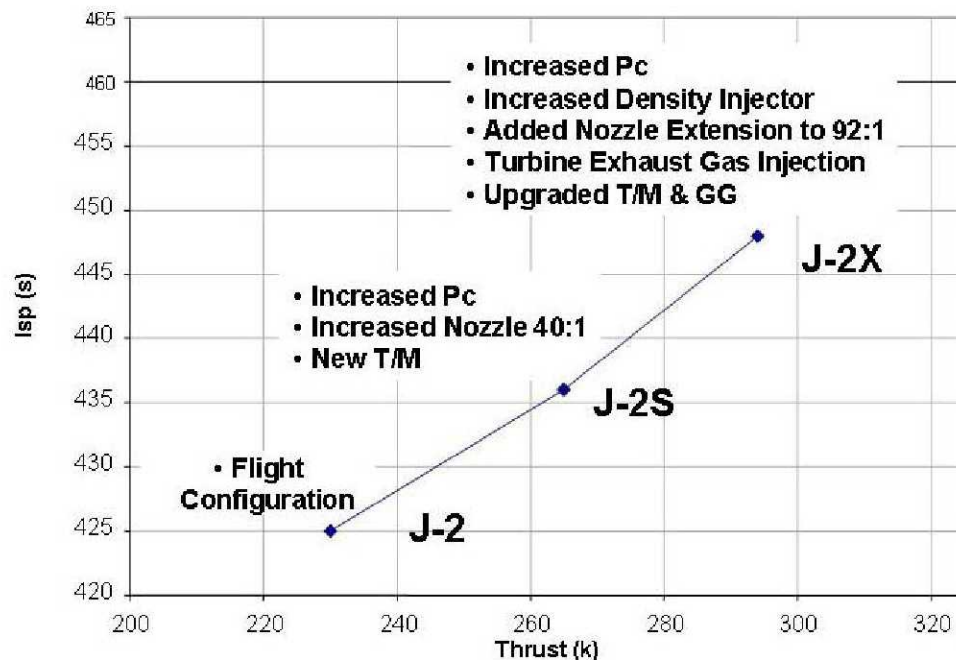
based on an evolution of the Apollo/Saturn era J-2 (GG cycle, 230,000 lbf, 424 seconds  $I_{sp}$ )...

increased to 294,000 lbf (1.3M Newtons) thrust...

increased to 448 seconds of specific impulse (highest ever  $I_{sp}$  for an engine of this class) ...

nearly two years faster than an engine of this class has been developed...

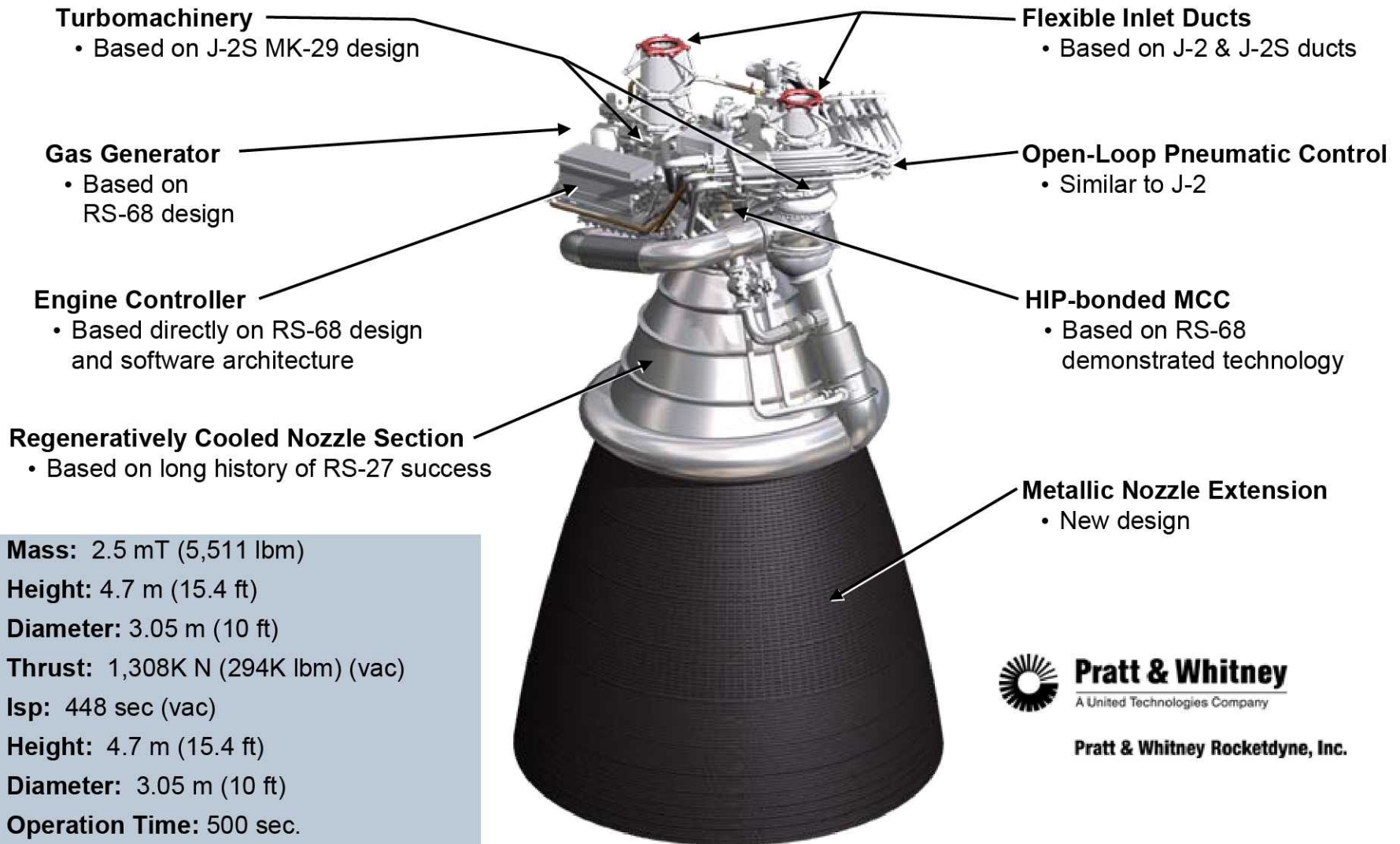
and make it work for two different vehicles with two different missions, keeping as much commonality as possible.





# J-2X Engine

## *Used on Ares I and Ares V*



### **Turbomachinery**

- Based on J-2S MK-29 design

### **Flexible Inlet Ducts**

- Based on J-2 & J-2S ducts

### **Gas Generator**

- Based on RS-68 design

### **Open-Loop Pneumatic Control**

- Similar to J-2

### **Engine Controller**

- Based directly on RS-68 design and software architecture

### **HIP-bonded MCC**

- Based on RS-68 demonstrated technology

### **Regeneratively Cooled Nozzle Section**

- Based on long history of RS-27 success

### **Metallic Nozzle Extension**

- New design

**Mass:** 2.5 mT (5,511 lbm)

**Height:** 4.7 m (15.4 ft)

**Diameter:** 3.05 m (10 ft)

**Thrust:** 1,308K N (294K lbm) (vac)

**Isp:** 448 sec (vac)

**Height:** 4.7 m (15.4 ft)

**Diameter:** 3.05 m (10 ft)

**Operation Time:** 500 sec.

**Altitude Start / On-orbit Restart**

**Operational Life:** 8 starts/ 2,600 sec



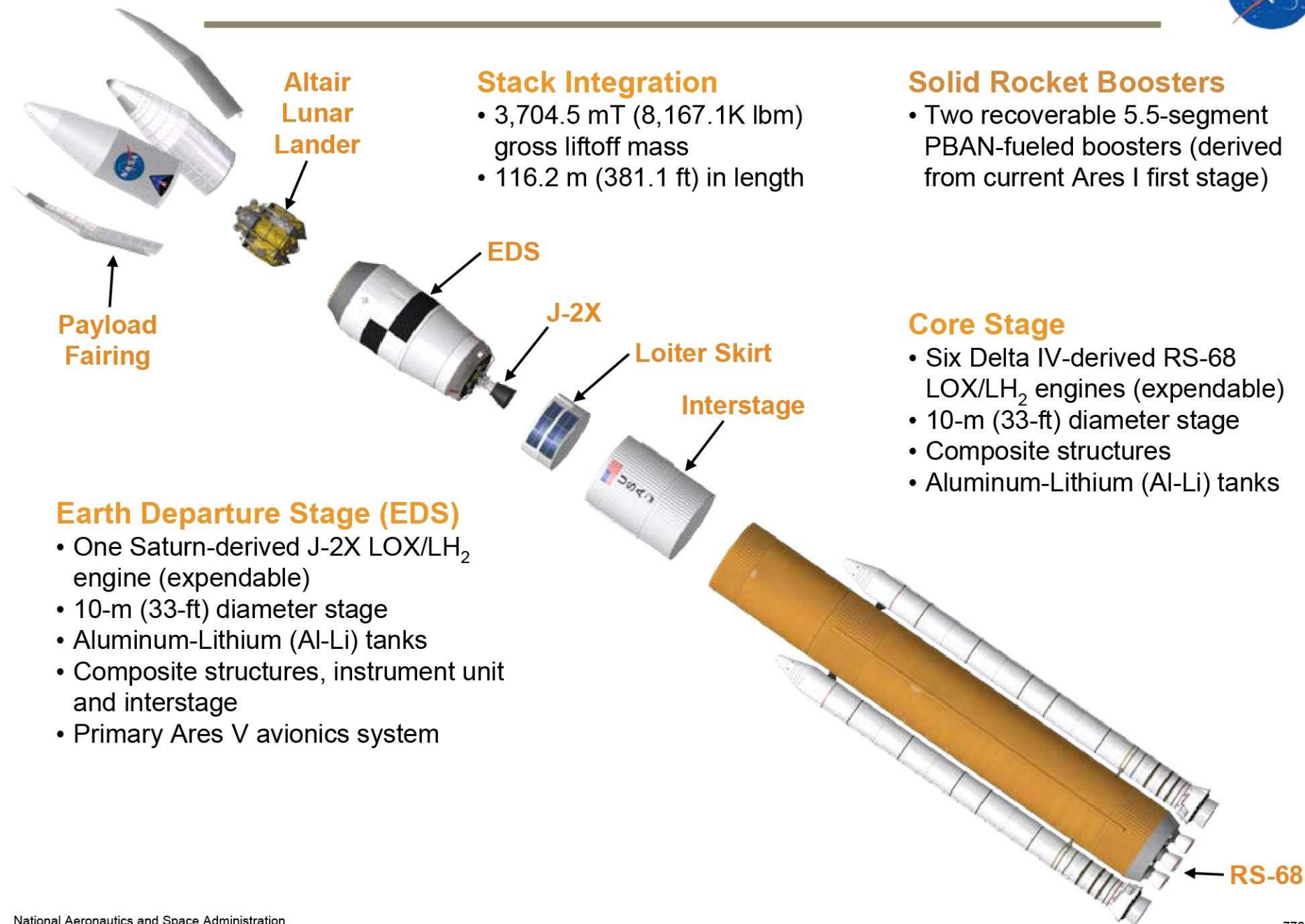
**Pratt & Whitney**

A United Technologies Company

**Pratt & Whitney Rocketdyne, Inc.**



# Ares V Elements





# RS-68 to RS-68B



\* Redesigned turbine nozzles to increase maximum power level by  $\approx 2\%$

Helium spin-start duct redesign, along with start sequence modifications, to help minimize pre-ignition free hydrogen

Redesigned turbine seals to significantly reduce helium usage for pre-launch

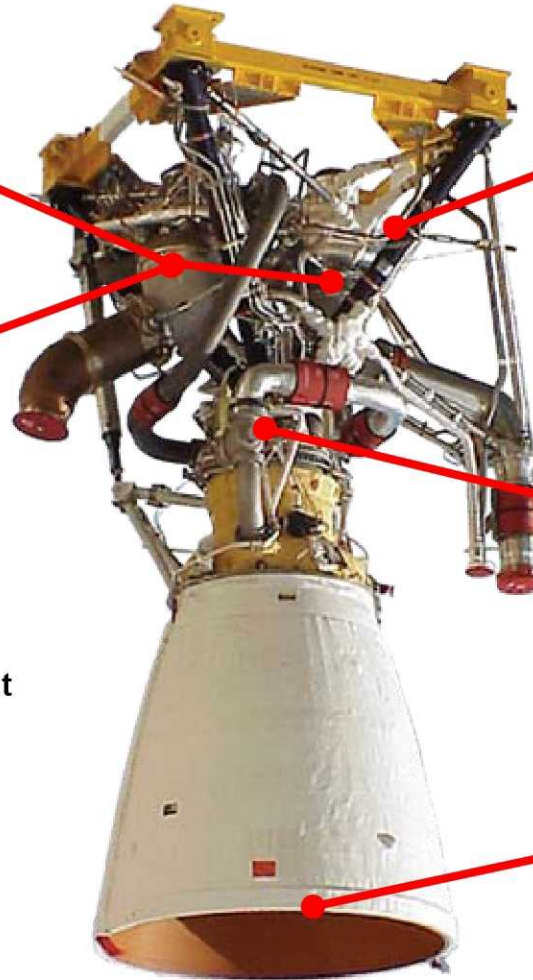
\* Higher element density main injector improving specific impulse by  $\approx 2\%$  and thrust by  $\approx 4\%$

♦ Other RS-68A upgrades or changes that may be included:

- Bearing material change
- New Gas Generator igniter design
- Improved Oxidizer Turbo Pump temp sensor
- Improved hot gas sensor
- 2<sup>nd</sup> stage Fuel Turbo Pump blisk crack mitigation
- Cavitation suppression
- ECU parts upgrade

Increased duration capability ablative nozzle

\* RS-68A Upgrades





# What Progress Have We Made?



## ◆ Ares I

- Ares I, First Stage, & Upper Stage PDRs complete in '08
- Numerous First Stage development and static motor casting & firing tests, wind tunnel, nozzle, materials, parachute drop tests complete
- All Ares I-X hardware at KSC for '09 launch



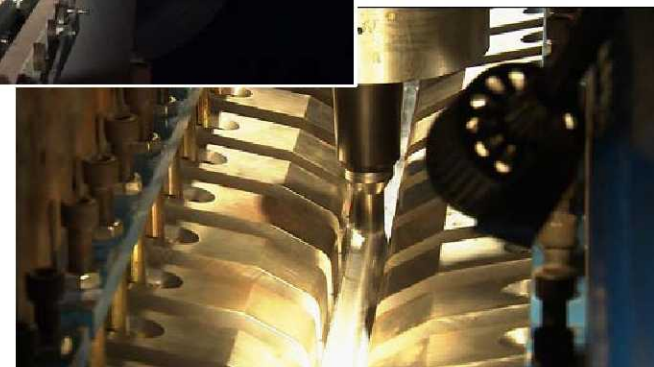
## ◆ J-2X

- Completed PDR in '07, CDR in '08
- SSC A-1 test stand converted, A-3 stand construction under way to support J-2X
- Numerous heritage, component, subscale, and powerpack tests and CFD completed in support of turbomachinery, combustion devices, etc.
- Casting/machining trials under way/long-lead parts procured

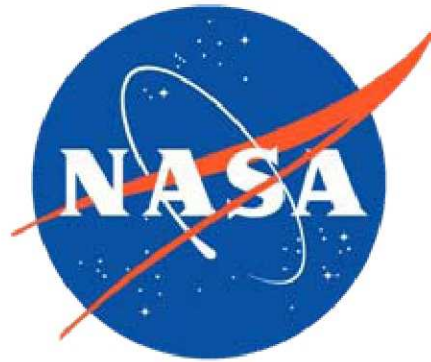


## ◆ Ares V

- Subscale main injector tests, analysis conducted on RS-68B
- LCCR establishes POD concept '08
- RFP for concept definition issued '09



For more information go to [www.nasa.gov/ares](http://www.nasa.gov/ares)



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